# *BUSINESS TOPICS*

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# business topics

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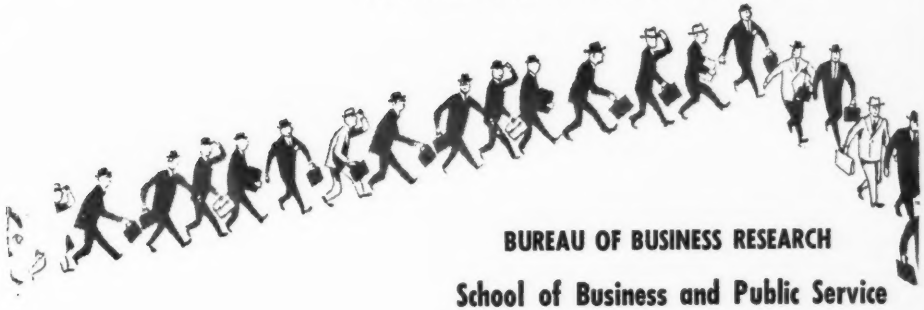

BUREAU OF BUSINESS RESEARCH
School of Business and Public Service
MICHIGAN STATE COLLEGE
EAST LANSING

## Education in Economics

A study of economics provides the fundamental basis for understanding business and its relationships to our society. It also develops abstract thinking ability that is important in personal success. The essentiality of economics in a college education has been long established: the subject has been taught at Michigan State for eighty years. Today the Economics Department provides a basic knowledge of economics for students with career objectives in business administration, government service, law and many other fields.

Many students elect to major in economics. Six areas of specialization are offered, and enumerating them also suggests the variety of subjects taught in economics at Michigan State: (1) Money and Banking; (2) International Economics; (3) Public Finance and Fiscal Policy; (4) Labor Economics and Industrial Relations; (5) Economic Thought; and (6) Free Enterprise and Public Policy. Most majors are advised to select a broad variety of courses from these fields, particularly if they expect to occupy executive positions in business or government. Business administration and related social science elective courses also provide this breadth. Master and doctoral degrees are offered by the department, as well as undergraduate programs.

The Economics faculty's services go beyond the classroom. They work to further economic understanding in conferences and extension programs arranged by the Continuing Education Service on the campus, in plants and in community meetings. As individuals they assist trade and government groups at home and in foreign countries.

An important activity is the annual Economics Workshop, which is conducted for teachers at all levels of education, jointly conducted with the School of Education. Teachers enrich their school instruction in these sessions where they are brought abreast of current economic issues and thought by leading economists. Thanks to financial support by businessmen, scholarships enable many of the teachers to participate who could not otherwise afford it. Thus do Michigan State's economists work in many ways to benefit their state.

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*"Let your discourse with men of business be short and comprehensive."*

(George Washington's *Copybook*).

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# *AUTOMATION— From Four Viewpoints*

Everyone in the state must know by now that this is our Centennial Year. A major feature of the commemoration of this event has been a series of symposia, for which the various Schools have brought leading figures to the campus. A hundredth birthday is an opportunity for gathering our forces as we move into our next hundred years. It was with the future in mind that the School of Business and Public Service chose as the theme of its symposium *Business in the Future. Business Topics* is happy to be able to reprint the following four talks, given by four authorities on April 13, 1955.

## LABOR LOOKS AT AUTOMATION

*By JACK CONWAY**

A new American myth is being created. High priced public relations "experts" are saturating us with a barrage of material that sets technology upon a pedestal and pictures man worshipping at its base. Even more than free enterprise, improved technology is cited as the cause of reduced hours, higher wages, more jobs, and improved living standards. We are led to believe that technology automatically confers benefits on society. Technology is represented as the independent variable, the causal factor. But this is not true. Man is the independent variable. His customs, his habits and traditions, his desires and needs, his ingenuity, resourcefulness and wisdom determine the shape, kind and degree of prosperity he can and does wring from the natural resources of the world.

As a consumer and as a politically franchised citizen, a man makes decisions affecting the number and kind of jobs. Across the bargaining table, for example, and by political action, workers attempt to improve their living standards. When these efforts, however, take us into the area of management directed technological considerations, the thickest smokescreen imaginable is generated. We are told, "don't worry about the future." The glorious new world of tomorrow is on its way. The Chamber of Commerce states, for example, "you can assure your employees and community that they'll be among automation's beneficiaries. Automatic machines will increase everybody's living standards." The NAM in its pamphlet, "Calling all Jobs," tells the community the same story. In it we are welcomed aboard the magic carpet for a wonderful ride to far and undreamed of horizons. The impression is created that all of these things will take place automatically. One

*Mr. Conway is Administrative Assistant to Walter P. Reuther, President, UAW-CIO and Chairman UAW-CIO Committee on Automation.

management spokesman at a *Fortune Magazine* sponsored round table a few years ago stated, "I don't think we are consciously trying to ease the burden of our workers nor consciously trying to improve their standard of living. These things take care of themselves. They have a feedback of their own . . ."

### Myth About Technology

This is the management propagated myth: Technology automatically determines standards of living. No one brings technology into being. It springs naturally from the ground like creations of nature.

The purpose of attributing to inanimate machinery the ability to make progress automatically is clear. If machines can automatically give us higher living standards, more leisure, and the better life, then on what grounds do unions make demands for higher wages and for better working conditions? Why struggle to make progress when automation automatically provides progress? It wasn't so long ago that companies were telling workers that unions were unnecessary because workers would get their just rewards without organizing. Working people rejected that falsehood then. They reject now the idea that progress is made automatically. All of us, in all segments of our society, working together, must harness our productive tools to beneficial ends. We must match our greatly improved power to produce by a greatly broadened and deepened purchasing power base. For only as we remain able to consume what we make can our delicately balanced economy function properly.

One remaining canard needs to be disposed of before getting down to brass tacks. When unions point out that drastic changes in production techniques have, as a by-product, disruptive effects on the lives of workers —out come the straw men. Management claims that this is conclusive evidence that workers are afraid of new machines, that workers oppose automation. This is not true. Workers do not oppose automation. We do not fear the automatic machine. We welcome better tools that take the danger and drudgery out of our work. What we do oppose is blind, irresponsible use of these new tools.

We say management has a responsibility to introduce this new technology in a manner which will minimize disruptive consequences. It must time automation installations to coincide with expanding needs for the products. Management must face its responsibility to the workers affected by changes in technology. The purpose of this new machinery is not to create unemployment but to create abundance. Conscious management decisions are made to install the new methods. These decisions should be socially responsible and should take into consideration the welfare of the workers affected.

### The Guaranteed Employment Plan

We in the UAW will do our part to insure that management takes its responsibilities seriously. We are demanding a guaranteed employment plan in the current negotiations. That plan is designed to encourage management to smooth out seasonal and cyclical fluctuations in production to the best of its ability, to provide steady employment not only day by day and week by week, but month by month throughout the year. If management fails to do this, the cost of unemployment will not be borne, as it has been in the past, by the worker and his

family alone. Management's sensitivity to financial penalties is well known. The UAW plan will take full advantage of this sensitivity and thereby cause management to give more attention to the socially desirable goal of stabilizing employment.

Under our guaranteed annual wage plan, management would tend to avoid the introduction of automation when major layoffs would result. The introduction of new and more efficient equipment would more likely be geared to periods of expanding markets when other jobs would be available for the workers displaced by new machinery. Similarly the guaranteed annual wage would tend to assure that new and more efficient plants are located reasonably near the obsolete ones so as to avoid mass layoffs of workers in existing plants.

Under the guaranteed annual wage, as you can see, management will more likely make decisions affecting the introduction of automation with a greater degree of social responsibility. Where the introduction of automation nevertheless would result in displacement of some workers, the guaranteed annual wage would serve to cushion the shock of layoffs. It would give these displaced workers up to a year to find jobs in keeping with their experience and abilities or enable them to undertake retraining for new and better jobs made possible by the new technology. The corporations moreover would be impelled to provide various types of aid to displaced workers to minimize their period of adjustment. The coming struggle to obtain a guaranteed annual wage is just the present chapter of labor's historic fight to provide greater employment security for wage-earners.

### How Many Jobs?

Looking beyond this present phase of labor-management preoccupation, we must ask ourselves, "How many jobs will there be? What kind will they be? And how fast will the changes come upon us?" The first questions to be asked concern the growth of population and the size and composition of the labor force of today and of the future. How many men, women and children of what ages are and will be seeking work? How many hours a week will they work? At what age will younger people enter the labor force? What will be the average age at which older workers will retire? These and other questions require some answer in order that we can determine the total labor input.

Our labor input is a function of (1) the number of people working; (2) the length of their working life; and (3) the number of hours they work in any one year. Once this is determined, then we know how many jobs must exist. If our economy is not expanding at a sufficient rate to provide these jobs, then we must act as a people to insure that the rate of expansion be changed accordingly. Or, we must change our input by shortening hours or reducing the work life.

A brief review of the employment picture in manufacturing during 1954 provides a graphic example of the problem that we face now and the much larger problem we will face in the future. Between November, 1953, and November, 1954, government statistics showed that the number of job seekers, that is, our civilian labor force, increased from 63,905,000 to 64,624,000 people, a gain of 719,000 workers, or slightly more than one per cent. The index of manufacturing output, how-

ever, was 132% in November, 1953, and 132% in November, 1954. Manufacturing output did not increase but productivity increased sufficiently so that 887,000 fewer workers were required to turn out this same output. There were 16,988,000 workers employed in manufacturing in November, 1953, but only 16,107,000 in November, 1954—a drop of 5.2%. What does this add up to? It adds up to an average of 3.3 million people unemployed in 1954 with little chance for re-employment unless we increase total output significantly or reduce labor input by shortening the working life and increasing leisure.

It is now estimated that the average yearly growth of the civilian labor force is some 700,000-800,000, and will continue to rise at an increasing annual rate within the coming decade. This year the civilian labor force may increase by 900,000 to a million, if the size of the Armed Forces is reduced as planned. In two or three years, the growth of the civilian labor force will be accelerating, as those who were born since 1939 start looking for jobs. The annual growth of the civilian labor force within the next five years will likely be about 800,000 to a million a year. Between 1960 and 1965 the average annual growth of the civilian labor force will probably be about a million to a million and a quarter.

This means that the civilian labor force, which has been growing at an average annual rate of about 1% in the recent past, will be expanding at an average rate of about 1.2%-1.8% a year in the decade ahead. An increasing number of job opportunities will have to be created each year if full employment is to be attained. Productivity too will probably be rising at an accelerating rate in the period ahead, at the very time when civilian labor force growth will also be accelerating. The rise in productivity means more output per manhour. But it also means that if the nation's total production of goods and services stands still, millions of workers will be displaced because their manpower will no longer be needed.

In the recent past, productivity has been rising at an average annual rate of close to 4%. Improvements in labor skills, in existing machines and work flow, when combined with the introduction of automation, could well bring average annual productivity increases to 5%-6%, or more. A 5%-6% average annual rate of productivity increases may well be a conservative estimate, when one considers the changes in technology that are now taking place—not to mention the impact of atomic energy. The successful trial run of the *Nautilus*, for example, started a rush by manufacturers to secure AEC licenses for industrial uses of the atom.

Turn now for a moment to the future. Let us assume it is feasible and socially desirable to attain the following goals by 1965:

1. A reduction in the workweek to four eight-hour days;
2. A reduction in the percent of population in the labor force by permitting young people to stay in school longer, and freeing older people from the necessity to work long after they would have retired if they had sufficient pensions; and
3. A 20% increase in per capita income.

Census data show that in 1965 there will be 24 million people between 14 to 21 years of age. A continuation of the present labor force participation

rate would mean 11 million of these youngsters would be working and 13 million would be in school. But we should not be satisfied with the status quo. We should raise the minimum age at which people start work. If we enabled all people 21 or under to attend school by making it economically possible for them to do so, we would reduce the labor force by 11 million people.

### Older Workers

Now let's turn to the other end of the scale, the older people. In 1965 we will have 17 million people over the age of 65. A continuation of present labor force participation rates would mean approximately six million of these older citizens would be in the labor force. By 1965 we should be able to raise pensions sufficiently so no one over 65 who wants to retire will be forced to work by economic circumstance. Let's assume that half of our oldsters want to keep working but that the other half, 3 million people, retire on a decent pension.

These two measures, shortening the work life by encouraging later starting and earlier retiring ages, will cut the census projection of the labor force of 1965 from 79 million to 65 million. This figure again will be reduced by the number in the armed forces and those temporarily unemployed because of job shifts or for other reasons. Assume that 3 million people are in these two categories and we end up with an employed civilian labor force of 62 million people. This employed civilian labor force I have projected is approximately the same as the one we have at present. But there would be significant differences. The very young and the very old would not be working. And hours of work for those working would be reduced. As I stated previously, I assume a 4-day, 32-hour week would be obtained by this arbitrarily-chosen date of 1965. In this interim period, while hours are being reduced, productivity will be increased. It is impossible now to forecast the rate of increased productivity, but it should be at least greater than at present. An annual 4½% increase would easily provide a twenty-percent increase in per capita consumption as well as the 20% reduction in hours.

I realize I am speculating about goals that the people of the country will determine freely and democratically—and the labor movement will participate vigorously in that process. I am not attempting to force my ideas upon you. The figures I have used are illustrative in character; they are not the policy of my union nor are they even my own personal convictions. I have, in fact, been deliberately conservative to avoid the risk of frightening you. What I have attempted to do is focus your attention on a conceptual framework within which all of us will join in determining our labor input—that is to say, the number of employment opportunities.

In order to be able to make the wisest decisions about employment opportunities, the people of this nation must have full access to the information necessary to formulate a sound program. In this connection I would like to call your attention to a resolution passed at the recent CIO Convention. This resolution concludes with the following statement:

" . . . This Convention calls upon the Congress of the United States to investigate and to report upon the present and prospective impact of technological developments in our economy; to determine the extent to which

such developments have already caused displacement of manpower in industry; to obtain from employers information as to their plans for further installation of new processes and new machines designed to increase productivity, and their plans, if any, to insure that such increase in productivity is accompanied by expanded purchasing power; to determine the extent of further displacement of manpower that may be anticipated within the next several years and the geographical and industrial centers most likely to be affected; and based on their findings to make recommendations to insure full production and full employment in peace time."

### What Kinds of Jobs?

Now, let us turn to the qualitative aspects of the employment opportunity question—what kinds of jobs will there be next year and ten years from now? We in the UAW-CIO have been giving this question careful attention. Our continuing study of the impact of automation clearly indicates that vast and far-reaching changes in job content are in the making. In offices and warehouses, electronic data processing equipment is being introduced. This means that people who formerly performed, manually, such operations as filing, billing, inventory, payroll and the like will find the nature of their jobs changed drastically. Manual routine and repetitive jobs will be eliminated. Clerks will become office machine attendants and controllers. The drop hammer-oriented forge shop is being replaced by heavy press forging plants. The hammer operator and helper of today will be a press controller in the future. The modern press plant itself is changing at the same time. Manual handling, loading and unloading are disappearing. Automatic iron hands are being substituted for human ones. Conveyors and transfer machines are replacing lift truck operators and material handlers. Welding is becoming more and more mechanized daily. Manual arc, spot, seam and gun welding are giving way to automatic machine welding.

Machining operations are undergoing a complete transformation. Hundreds of standard-type machine tools are being grouped on one large base. The piece to be machined is automatically unloaded and moved from tool to tool. The machining operations are performed automatically. The operator who formerly regulated the feeds and speeds of one machine tool now supervises an electrical panel board. This board shows the performance of the many tools used in these new giant machines.

In the long run, these changes pose less difficult problems than in the short run. Students now in high schools and colleges can be given educations that fit them more readily for the future. The children in grammar school will grow up in the world of the new technology and take to it like ducks to water. We can take nothing for granted, however. The task that confronts our educational system is a staggering one. We must be prepared to pay whatever it takes to keep that educational system constantly up to date so that when our youngsters are ready to go to work they can do so as well grounded, soundly equipped citizens prepared to participate fully in society. But in the short run we face the immediate obsolescence on a large scale of the skills of adults. I am confident that the American public does not wish to make progress at the expense of those directly affected by automation.

It is true that many management spokesmen recognize the problem. A Ford spokesman, for example, has stated: " . . . the hand trucker of today replaced by a conveyor belt might become tomorrow's electronics engineer . . . drill press operators replaced by automatic multiple drilling machines could be trained as future tool makers."

But recognizing the problem and doing something about it are two different things. We can all recognize the need for more skilled workers and electronic engineers. But skilled tool makers or electronics engineers are not made overnight. Within individual companies, management and union must take the responsibility to insure that workers whose skills have been rendered obsolete are afforded the opportunity at company expense to acquire new skills. This will take time, energy and some foresight. Conscious decisions are made to change the method of production. These decisions can be totally irresponsible, however, if they do not include provisions to retrain workers without loss of wages who are affected by those changes. When management makes decisions to "automate" production, it becomes necessary for workers through their union to "automate" the wage, classification and seniority structures in the plants. Just as old machinery becomes obsolete in the new technology, so do wage rates, job classifications, seniority groupings, and wage payment methods. These too must be modernized, and the task is not easy. It will become the subject matter for hundreds upon hundreds of collective bargaining meetings of the future, in factory after factory, large or small, from one end of our land to the other. Our mass production industries today are in a stage of development in which automatic controls are being substituted for human operators who perform repetitive jobs. The industrialization process is finally reaching its culmination. Skilled artisans have been replaced by machines over a period of a hundred or more years in which factory managers and time and motion engineers have "atomized" the task—broken the job apart into as many simple repetitive machine jobs as possible. The process of sub-dividing jobs and substituting machines for manual processes gave birth to the assembly line of today. Now the human operator has become the bottleneck—and the process is reversed. By grouping functions, redesigning products and factories, by automatic loading, unloading, regulation and performance of a job, the unskilled worker is being eliminated. But on the other hand, the design, maintenance and control of these new machines give rise to new occupations, or expanded needs in existing skilled maintenance occupations.

Census data show that between 1910 and 1950 the largest growth by far in any major occupational group was that of 116% of clerical workers. But it would be dangerous to assume that those in the general laborer classification, which declined 60% in the same period, should be trained as clerical workers (UNIVAC and other similar electronic equipment may drastically change the rate of growth of the white collar occupations).

Nor is it enough to have an idea of which occupations are growing and which are declining. There also are shifts from industry to industry. A simple example within the jurisdiction of the UAW is that of the number of workers in the aircraft industry as compared to those in the automobile

industry. In 1954 there were more aircraft workers than auto workers. In the past, with the exception of the war, the reverse has generally been true. The census shows many other broad shifts. From 1910 to 1950 "finance, insurance and real estate" was the fastest growing industry with employment up 217%. But during 1940-1950, when this industry increased 38%, public administration increased 54%. The qualitative problems we face are many and serious. Transfers from industry to industry or occupation to occupation are not automatic. Provisions must be worked out to insure that the people affected by the changing nature of job opportunities are not unfairly penalized. The problem of readjustment and retraining to create the most effective labor force of the future is not one which can be handled solely on an individual plant basis.

Government must do its part. We need an efficient nation-wide employment service. Vocational and general education facilities for adults must be expanded. Our educators themselves must be educated. Many of them appear to believe that man stops learning when he reaches age 25. The educational programs of this country were designed to help children. Little has been done to help the mature adult who wishes either vocational or general educational training. Over the next ten years the technologically displaced adult is in danger of becoming the "forgotten man" of our society. We must not let this happen. To avoid this possibility, we must understand the nature of the problem that faces us and its probable magnitude so that we can proceed intelligently to meet and solve it both for the long run and the short run.

**An Appalling Lack of Knowledge**

We are handicapped today by an appalling lack of knowledge of the actual and prospective impact of the new technology, without which we cannot proceed rationally to deal with it. No one knows the extent to which it has already established itself in industry or the pace at which it is likely to advance even within the next few years. The individual company knows only what it has already accomplished and what further innovations it has on the drawing boards and in its capital budget for the future. It knows little or nothing of what its competitors are planning to do and even less of what is planned in other industries. An essential first step is to pull together, at least from the giant corporations that dominate the economy, the facts as to the impact of automation thus far and its probable impact in the near future. Equipped with the facts, the American people, through the agency of their free institutions and their government, can prepare and plan to harness the potential good and ward off the potential evil implicit in the new technology.

In conclusion, let me say, that the attitude of the UAW-CIO toward the new technology is a constructive one. We say "Automation must be met sanely and constructively so that the miracle of mass production—and the ever greater economic abundance made possible by automation—can find expression in the lives of people through improved economic security and a fuller share of happiness and human dignity. Sensibly, rationally, scientifically we intend to harness this radical new force in our lives, using its potential to produce an era in which well-being, justice and peace will be the universal possession of all mankind."

# THE ELECTRONIC COMPUTER: TOOL OF THE FUTURE

*By Leonard Spacek**

*Management's Tool of Automation.* The field of automation is so broad that I can contribute most by staying within somewhat narrow limits. It is my purpose to outline reasons why computers can contribute so much to the solution of management problems, what management expects of computers, the present status of computer development generally, and our experience and recommendations as to how to proceed. Electronic computers will have a greater labor displacement effect than all prior forms of office mechanization. However, with proper planning, the effect on clerical labor can be gradual rather than a radical change. *Positions,* rather than people, will be eliminated, and the normal turnover in most companies will absorb the effect of displacement. Computers eventually will make office work more interesting and will create higher-paying jobs because the greatest changes will take place in the area of routine clerical work. The clerical force in this country is estimated at one-eighth of the total labor force and two-thirds of this group consist of women, many of whom do not plan on permanent employment. Planning and the gradual changes due to electronics should permit this problem to be solved relatively smoothly. Management has a responsibility to anticipate these problems and to make long-range plans to insure that this is achieved.

*Automation; an old story to production's side of business.* Automation has been a gradual and continuing process and has been a well-known industrial technique for many years. Utilities, for example, had automatic power plants in the early 1920's and the production capacity of utilities for electrical energy has multiplied sixfold in the last twenty-five years, while the productive labor force in the same industry increased a small percentage—perhaps 10 percent. Manufacturing, particularly automotive, has had wide publicity for automatic techniques. But food processing, oil and chemical companies, and many others have made steady if not spectacular progress. The result has been to increase production and wages and to shorten the work week. It has been the achievement of aggressive production leaders in business, both labor and management.

*Time Lag in the Office.* However, this pace of automation up until recently was not matched in the office. In fact, the clerical labor force grew and grew, leading all other classes of employment in the rate of growth. From 1940 to 1950 it expanded about 60 percent. There are two interrelated reasons for this: business transactions grew very complex as accounting refinements developed; and as government bureaus put tremendously increased demands upon them.

*Computers: their distinguishing features.* Automation in the office now has received tremendous publicity from

*Mr. Spacek is a Certified Public Accountant and a Managing Partner of Arthur Andersen & Company.

a new tool which gives promise of bringing mechanization in the office up to the level of that in the factory. I refer to the electronic computer. What are the features of computers that will permit us to mechanize far beyond previous levels? The most important features are two: 1. Tremendous speed of operation approaching the speed of electricity and replacing the speed of the mechanical wheel and gear. 2. Automatic progression in a work program and process accounting data without human intervention — this ability is often referred to as *automatic sequencing*.

One of the immediate benefits of computers is the reduction in clerical costs due to greater speed and automatic handling of data. But, in addition, the computer has capabilities that permit immediate benefits of reduced clerical costs which have up until the present been impossible. Before the development of computers, probably not more than one-fifth of all clerical work was mechanized. Existing forms of mechanization were unable to cope with routines requiring simple decision-making ability; such steps made up by far the greatest area of clerical effort. This ability in the main involved a series of positive or negative decisions. It developed that a computer, properly programmed, can do the job faster and more accurately. For example, a computer can determine just as well as a clerk whether an employee is entitled to overtime (a yes or no comparison with a standard), whether social security deductions are to be made, whether shift premiums apply, whether union dues are to be deducted, and others. This new ability, found in the computer only, has opened the doors to great new areas of mechanization and greater areas of clerical savings. These then are the immediate benefits; they have important bearing on reductions in the cost of handling data. Ideas and constructive experimentation will have their greatest play in the area of long-range benefits.

*Large Companies Installing Computers.* As for the present status of computers in business: A lot of publicity has appeared and a number of large companies have installed computers or are in the process of doing so. The first general busines application was that of General Electric at Appliance Park in Louisville, and that installation is proceeding satisfactorily. Others have been installed or contracted for by United States Steel, Monsanto Chemical, Metropolitan Life Insurance, and Commonwealth Edison of Chicago, among others. General Electric plans to project its computer into practically all areas of its operations and so does Commonwealth Edison. The latter will first convert its highly mechanized punched-card billing operation to the computer and will subseqently convert all general and cost accounting operations to electronic operations.

Hence, the larger companies have made the decision to go ahead with computers and have learned from their studies that the benefits to be gained greatly out-weigh the rather substantial rental or purchase costs. For large companies, there are many different applications as contrasted to limited-purpose applications. It is well to keep in mind that while the installations of these first computers have been slow and have required great, prolonged effort, this period has been a learning one. Future installations will be made in less time, with less work and with less cost. New methods of installation

might well use the computer to assist in solving the problem of its own installation.

*Effect on Smaller Companies.* It is obvious that large scale computers have progressed beyond the blueprint stage and that many large companies will install them during the next few years. But what of the small company —where does it stand in the area of the computer? I understand that of the total number of manufacturing plants in this country, well over 90 percent employ less than 250 people, but account for well over one-third of the people in the manufacturing labor force. There are only a few thousand plants in this country employing more than 1,000 people. Even though substantial numbers are employed in utilities, trades, and services, the smaller companies predominate. It seems obvious that if electronics is to benefit our economy to the maximum, its use must cover the smaller companies, particularly if computers become an advantageous tool competitively. There is great activity in research and development of smaller computers, which are just beginning to come on the market in numbers. The primary difference between the large scale and the small scale general-purpose computer is one of speed, not memory capacity. Though they are slower, they are still infinitely faster than any existing punched-card equipment, and for many of the smaller companies their speed is more than adequate. Most of the office machine companies that have been in the field are developing electronic applications and are planning changes, modifications and new designs to keep abreast of progress. Great possibilities of further reductions in cost exist when electronic recording of source material (input data) becomes extensive, and equal benefit will be realized when printing and recording speeds (output) are greatly increased to handle results from the computer process. It is by no means beyond the realm of possibility that service bureaus will permit sharing of computers by smaller companies.

*Ability to Reflect Changes in Involved Variable Reports.* Let me point out some of the reasons why computers have developed. The complexities of business have slowed up the preparation of reports to the point that they have become more and more obsolescent and hence less and less useful. The need for accurate information on a timely basis could not depend upon reports a month or even a week late; so businessmen, of necessity, have leaned more on judgment as a substitute for current information. Predictions of the trends in business also were made by intuition because significant statistics were either too costly to obtain or too old to be effective. In the last five years, industry has spent about 125 billion dollars for important new facilities. Business has become more competitive and good answers to questions such as what to produce, when to produce, how much to produce, where to produce have become vital to the successful operation of a business. There are questions requiring judgment as to business in the future, and historical data, properly analyzed and interpreted, helps significantly in making good decisions. It is important to be able to make a great number of assumptions as to sales and production costs and to get the net result of each assumption so as to set the best course of action. The long-range benefit to business will come in

an ability to accumulate historical data in a variety of ways, to make forecasts using this data, coupled with variable assumptions and the ability to reflect changes in the forecasts, all in an accurate, rapid manner. Without computers this was effectively impossible; with computers, it is relatively easy. Many well informed people believe this capability will be the greatest benefit from computers, and that all-over economic benefits will result from stabilization of production and the resultant desirable stability in employment.

*How a Computer Can Be Used in Sales, Production, & Inventory.* What does all this mean in terms of specific application? First, it is as important to change forecasts and budgets in response to changed conditions as it is to make the initial determinations. Most business problems relate to sales, production, and inventory because they are so interrelated that a change in one area produces an effect in the others. Maximum profit results when control and proper meshing are attained in these related areas. When the obverse is true, there is trouble in the form of excessive inventory or inefficient production or labor instability. Let us see how a computer can help in the fields of sales, production, and inventory. As to sales, business will be able to accumulate great quantities of statistics and market data to show how its products have been accepted and to determine future sales policies. Price and distribution studies can be made and sales forecasts can be prepared quickly and accurately in response to any number of assumptions. Coupled with this is the analysis of product mix. This applies to the production of a variety of products often with style, model, and size factors and, also, to complicate the picture, a number of different plant locations. The job simply stated is to determine how much to produce of each product (taking model, style, etc. into account) in order to achieve a maximum profit. The variable factors are so numerous that only with computers can reasonable answers be worked out. Before computers, rough attempts to do it were made which generally were inadequate and often erroneous.

So far our computer has helped us project our sales goals and set production targets. Next we move to production scheduling which most business men will agree is one of the most difficult to control. It is a major problem to most manufacturing companies because good control before computers was attained only by use of costly clerical help. A large automotive manufacturer is reputed to use thousands of people in this function alone. Production control usually starts with a production forecast in finished units based in turn upon the sales forecast. Now production is exploded into material components and parts which must be turned into material schedules by months. In turn, considerations must be given to manufacturing time by outside suppliers, plant capacities, labor requirements, and many other factors significant to a stable production process. Inventory policies must be set in relation to production schedules, so here again the computer finds a fertile field. Still another related aspect of production is the determination of assembly line setup, or balancing, to achieve the maximum labor efficiency in production. Such factors as the number of work stations and conveyor speeds must be correlated to achieve the best results. In this area, too, computers can process the considerable number of variables and substitute

scientific computations for guess work. In fact, many companies now employ a scientific technique called Operations Research to help solve this and many other production, sales, and inventory problems. Again computers have provided a tool to permit the necessary data processing to take place.

*Changes in Original Reports to Reflect Changing Conditions.* Now with our computer, we have been able to forecast sales trends, determine products mix on a best basis indicated by our forecasts and schedule and control production and inventory. Assume that the market changes abruptly and we have to alter our sales goals sharply. In the past, without computers, by the time that the changes became apparent and production and inventory could be readjusted, business often overproduced, resulting in inventory losses and partial factory shutdowns, all reflected in lower profits, if not losses. Most production controls and forecasts made laboriously were quickly abandoned and expediency was substituted in response to top management's demands to cut back. Here many believe a computer will be of tremendous help. New assumptions as to sales and production trends can, with a computer, be quickly converted into new sales forecast and production schedules. Cancellations of material requirements, if necessary, can be made on an orderly basis, and peaks in labor force can be considerably smoothed. Savings in these areas alone can be substantial.

*Management Must Re-Examine its Organization.* There are many other areas where the use of computers can achieve long-range benefits. The sales, production, and inventory uses and, particularly, the ability to reflect changes illustrate some of the most significant. To accomplish all of these benefits, management must often play a pioneering role. Automation will require basic facts to be learned about each business, about its markets and sales demand, and about its products and labor force. Management, in its aproach to computers, is many times not in a position to contract to buy one, but also it cannot afford to delay considering a computer installation. The competitive advantages inherent in computers may severely penalize those who procrastinate.

*A Practical Approach to Electronics.* In this dilemma, what can a progressive management do? I believe, first, that it should be clearly recognized that the installation of an electronic computer is of such significance to all areas of business that top management should take an active part in the studies necessary to a decision. Unlike other forms of office mechanization, it is not a decision to be left to the controller. I suggest that management follow a program sequence such as this:

1. Get top management interest at the board level by discussion with competent people.

2. Select progressive, experienced men as teams to keep abreast of electronics, to study broad areas in the company, giving indication of computer applications. Include operating people on the teams.

3. Correlated with step two, begin to train people in the theory of computers. Arrange for them to learn to program, to chart, and to code, and to acquire a proficiency in this area.

4. Make detailed studies of likely areas and evaluate possibilities of ap-

plication in relation to costs and potential savings.

I can't emphasize too strongly that this whole program should be a continuous one, requiring frequent reports to top management, since computer development is moving rapidly. If nothing else is obtained, your organization will benefit from the clearing up and simplification of procedures and the clarification of organizational responsibility, both of which may produce cost savings and better performance whether or not a computer is installed.

*Conclusion.* A new and substantial industry is in the process of creation. We cannot yet predict clearly the extent of its growth and application. Many companies are spending huge research sums seeking better methods and faster methods. Without question, business needs computers, and the results of their use thus far amply justify the faith in their effectiveness as a new and powerful tool.

# MANAGEMENT PROBLEMS OF NEW PLANTS

*By R. H. SULLIVAN**

There is nothing of the so-called "push-button factory" at Ford Motor Company. Instead we have a number of fairly new plants using the most modern machinery and the most up-to-date mechanical handling equipment available. Our manufacturing goal today is just what it has always been: efficient, high-quality production at the lowest possible cost. With so much more value packed into today's automotive products, we have found it desirable to make increasing use of such things as automatic in-line transfer equipment and many other mechanical aids. The results achieved in some of our operations have been spectacular, according to the newspaper articles. But we see no likelihood in our industry of a fully automatic plant such as you might find at General Electric or among the oil and chemical companies.

Even in opening a partially automated plant, however, the management problems are somewhat diferent from those you would find in a plant where there was to be less extensive use of automatic machinery and equipment. It is these problems that concern me here.

Well in advance of the actual construction and manning of a new plant, there are certain management decisions to be made. There are first of all certain over-all objectives to be considered. Maybe the plant is simply to provide additional production capacity. Maybe it is needed to provide greater efficiency in operations. In any case, the decision to build carries with it a management responsibility to insure that the plant will be designed, built and equipped to permit efficient and economical operation.

### Advanced Methods for More Efficient Production

In any existing manufacturing operation there is always room for improvement. For example, there may be some safety hazard which has not been entirely eliminated. Then again, day-to-day experience may expose a deficiency in quality. Or we may find untapped possibilities for increasing production. So we try to design and engineer any new plant in such a way as to minimize physical discomforts or safety hazards for the worker and, at the same time, to produce required quality and to reduce costs. Such design and engineering would, of course, incorporate facilities representing the most advanced methods for more efficient production.

In our foundry at Cleveland, for example, we installed an entirely new system for sand handling and mixing in order to alleviate dirt and dust conditions which had been more or less accepted as a disagreeable necessity in foundries. At the present time you can't see that sand from the time it leaves the storage bins until it reaches the core machines, for it is delivered by air through a network of pipes. Knock-

*Mr. Sullivan is Vice-President of the Ford Motor Company and group executive in charge of several plants that include some of Ford's most publicized automatic operations.

out stations are equipped to dispose of loose sand from the castings in such a way that practically none of it can enter the air outside the hoods. The air in the foundry itself is completely changed *twice* an hour — a measure that represents a tremendous advance over earlier foundry practices.

This system not only eliminates what was formerly a disagreeable condition for workmen, but also reduces costs appreciably and delivers sand that is not contaminated by dirt or other undesirable elements. When the sand reaches the core making machines, it is ready to be shaped into the forms from which rough engine castings are made. The core making machines themselves are designed to reduce materially the lifting of core boxes filled with sand. The machines automatically jolt and squeeze the sand, and the entire operation is engineered so that the completed box is moved in the machine for stripping without appreciable effort on the part of the operator. This is just an illustration of the kind of design and engineering that is applied throughout the processing in new plants.

### Adequate Training

Another major management problem is setting up the work force, which, of course, introduces the greatest variable in the world — manpower. Ideally we should be able to recruit experienced people in all types of work. However there is little if any expectancy of recruiting the large number of production workers needed from plants making similar products, particularly at a time when business generally is expanding. In cases where a nucleus from an operating plant is desired, every effort should be made to cause as little dislocation as possible. The only solution in this situation is to provide means for the adequate training of new employees.

In the skilled labor area, there is usually no alternative but to recruit experienced people. And yet, even though able workers may be available, there again is a need for a period of training or at least of familiarization with special equipment. It is in this area that a real problem presents itself. After a very short time for becoming accustomed to the circumstances of a new job, the average worker is able to do almost any kind of production work. But it's not that easy to train the men capable of building and maintaining the equipment, even though it may be little if any different from what has been generally used on similar jobs.

Since the new plant is to be equipped with the latest developments in mechanical aids, there is an obvious need for larger numbers of trained men on such work. If we are going to provide a mechanical means for moving a component from one machine to another, it is first necessary to design and engineer the devices to do that job. So we need more engineers, for one thing. There is also a need for more mechanics to build the special devices and to maintain them. The ratio of skilled workers to production workers changes materially. Thus a carefully planned program of training is important, and we consider this requirement a definite part of our production planning.

While the adoption of automation usually reduces training time on a job materially for production workers, there remains the confusion involved in introducing a substantial number of people into a new plant. There may be excessive turnover, due in part to the

desire of some workers to try out a new plant for a short time and then quit. And of course there are always some restless people who cannot stay long on any job.

One advantage of a new plant is the potential seniority status to be gained by those employees who are among the first to be hired. This in itself might aggravate manpower problems in plants from which such employees came, but we believe there is progress all along the line when such opportunities for workers are opened up. An expanding company, like an expanding economy, of itself creates opportunity.

In the non-productive areas, such as quality control, safety, accounting and so on, the opening of a new plant creates similar problems. In some cases, people experienced in our lines of work must be recruited and trained to meet our standards.

### Supervision: The Most Pressing Need

Perhaps the biggest problem of all lies in manning the new plant with capable supervision. In our own new plant, as a rule, we do not transfer foremen from other plants, but select production operators as trainee foremen and give them special training, designed to provide them with fundamental knowledge of their responsibilities, and the logic and reasoning called for in meeting their problems, as well as the reasoning behind the company's rules and procedures.

In offering this training we again provide opportunity for advancement for ambitious men. As we see it, one of the causes of America's industrial supremacy is the opportunity given the individual for advancement and for further consequent contribution to industry. It is this type of incentive that stimulates men to use their existing ability to the utmost and to seek further knowledge and experience.

General foremen and superintendents are initially supplied, of course, from existing plants. Usuually they are men who were foremen in the plants from which they were transferred. But as the new plant comes into full production and the manpower is increased, many of the foremen — even some who may not have completed their trainee course—are promoted to these higher and more responsible jobs. 15 such trainee foremen have already been promoted to general foreman level in our Buffalo Stamping Plant. In the same place we have 167 foremen, *all trained within the plant.*

# AUTOMATION IN THE HANDLING OF MATERIALS

*By R. C. WAEHNER**

In its original connotation, automation implied the automatic handling of materials and parts as they progressed through production processes. Today, automation is used to describe continuity of movement with minimum exertion of manual effort in all fields of industrial activity. It is, in effect, a step towards the ultimate goal of combining the inventors' genius with the brainpower and adaptability of the American worker; as, in the final analysis, greater productivity is the only basically sound way to insure an ever-higher standard of living.

Automation has removed the drudgery from everyday manual labor, and utilized the abilities of the American worker to effectively use mechanized equipment. In recent years this has been particularly true in the field of movement. By movement, I refer to the physical handling of basic raws from the original supplier to the processor, and the subsequent handling of finished goods from production to the ultimate customer.

Lest we think that we, in recent years, have invented and conceived a further improvement in American industry, it is well to realize the practice of automation has existed for years in varying degrees. Only the term is new; but if the use of the new word serves to arouse the curiosity of industrial management, it is an invaluable addition to our vocabulary. In the past three decades, management has concentrated on the improvement of sales and production efficiency, and developed both to a high art; but little attention has been paid to receiving, warehousing, shipping, traffic, and distribution — all of which can be embraced in the one term, "Movement."

**Movement: The Third "M"**

Many prominent economists have stated that material handling can represent anywhere from 15% to 85% of the cost of finished products. On an average, they say 50¢ of every consumer dollar represents either transportation or material handling. The field of movement offers substantial reward to the company willing to place such responsibilities under the direction and control of a competent executive.

The potential cost reductions in this field have been available to management for years, as many of the basic concepts have long been fundamental possibilities. To grasp the potential savings in this field, management of the future should think of their organizational structure as divided into *four basic "M's."*

*Measurement* encompasses the measuring of a given set of raw materials, and determining what salable finished products can be produced; the establishment of quality and quantity controls; and research into better methods or new products.

*Modification* encompasses the conversion of basic liquids or solids,

*Mr. Waehner is General Manager of the Distribution Division of Lever Brothers Company.

through the process of manufacturing, from raw material into finished products.

*Movement* involves shipping of all goods—raw materials and packing materials—from supplier to the processor's plant, including intermediate storage; their passage through production processes, and transport of finished goods from the plant to branches, warehouses, dealers, distributors, and eventually to the ultimate consumer.

*Marketing* embraces the basic responsibility of creating a demand for the product; it comprises sales activity, promotion, and advertising.

Within the next decade, alert industrial management will recognize movement as an important part of their operational costs, regardless of what term they use to describe it—traffic, material handling, warehousing, or distribution.

Automation has existed for many years. It has been practiced in our soaperies in pumping tallow from tank cars into storage tanks, and the later flow through the various processes of converting the tallow into soap and many by-products, without manual handling at any time.

The perfect climate for the practice of automation occurs where orders for finished products are placed in advance of production. For example, several of our national bakeries secure customer orders for delivery two or three weeks in advance, and production begins on receipt of the order. Complete unitized flow exists from the supplier of the basic raws to the bakery, through his process, to the final consumer. The baker can schedule his raw materials to meet his order commitments, and take full advantage of automation by the use of material handling devices and specially-designed unitized loads provided by the supplier to coincide with his own production requirements. Automation continues through production to the delivery units, and product is never touched by human hands. This, of course, is Utopian. If all operations were that simple, there would be little need for automation technicians in modern-day industry.

### Effects of Automation

We are concerned today with the effect of automation on distribution and transportation, and what may occur in the future as a result of developments in this field. In recent years, the progress of automation has had a direct effect on the level of tonnage offered to the various forms of transport. In certain industries, some forms of transport have been aggressive in designing equipment specifically for their needs; but, by and large, transportation has not kept pace with the development of modern material handling methods undertaken in our industrial plants.

Material handling or automation is synonymous with speed and economy of operation. In our field, distributors and chain organizations are increasing stock turnover through automatic handling and, equally important, reducing dollar value of inventory levels. Axiomatically, this implies smaller but more frequent replenishment orders. This trend favors the motor carriers, as trucks have a smaller cubical capacity, and provide lower minimum weights.

There is likewise a trend toward palletized delivery. At the present time, palletization ends at the tailgate of the truck, but in the future it is reasonable to conceive that the units of sale and

discount may bear a direct relationship to the ideal, unitized load. This will require radical changes in motor carrier and rail equipment. The common carriers, both highway and rail, must undertake engineering activities in collaboration with shippers to overcome the unfortunate fact that the bulk of trailers and railroad rolling stock effectively prevents automation beyond the shipping platform. The speed with which the common carriers provide such equipment will directly determine future tonnage levels.

In England today, the railroads are providing shippers with special box cars designed to handle palletized materials. When cars of such design progress beyond the drawing-board stage and become a reality, the common carriers of our country will recover tonnage that industry has diverted to contract and private carrier because of their ability to provide special equipment. The old adage still applies, "If you wish to be competitive tomorrow, you must be progressive today."

### Lever Brothers' Experience

I can best cite the progress of automation and its effect on transportation by relating the experiences of our company in its quest to reduce expenses, to enable us to continue to deliver a high-quality product at competitive price levels to our customers. Not too many years ago, raw materials were purchased indiscriminately to take advantage of rising market prices, without consideration of the problems and expense in storing and ultimately delivering these raw materials to the production line, and, specifically, with little consideration as to the over-all effect of the subsequent handlings on the cost of finished goods. Such situations frequently resulted in substantial demurrage charges, plus costly outside storage and handling, and subsequent transit charges, or if transit was not available, prohibitive trucking. We have in recent years developed integration and communication with involved departments to a highly refined science of the relationship of needed component ingredients, not only to weekly, but daily production requirements, enabling the Distribution Division to intelligently move raw materials from the suppliers' point of business to our production lines. From the standpoint of transportation, this has required close collaboration by our Traffic Manager with transportation officials for the maintenance of rigorous schedules. By "rigorous schedules," I do not mean special, costly, hot-shot service, but consistency in elapsed time between suppliers' place of business and our production lines, as a delay of 24 hours could conceivably result in a shutdown of our plant facilities.

A perfect example of such stopwatch scheduling exists between our company and our can suppliers. Cans are loaded loose in railroad cars, ready for use on the production line, and are efficiently moved by conveyor direct to the production line. Previously it had been necessary to store cans with subsequent rehandling, incurring costly labor to manually feed into production lines. In addition, rehandling caused substantial damage. Countless thousands of dollars were saved by close collaboration between supplier, transportation carrier, and processor. Today this is a standard procedure in canneries throughout the country.

We collaborate daily with our Purchasing Department and, through their efforts, have encouraged many suppliers to furnish our various packing

materials and sundry raws in unitized loads, each directly related to the unit of use at the particular point of the production line, giving full consideration to space limitations and hourly requirements and, in most instances, avoiding intermediate handling. There are two considerations: the area available at point of use, or, if this is not a factor, the largest practical unit size, due consideration being given to worker fatigue in handling. For example, it is our opinion that a unitized load requiring an employee to reach above 6 feet or bend to within 18 inches of the floor will result in undue fatigue and over-all reduction in efficiency. It is therefore apparent that automation begins with the design of the production line—the providing of floor loads of sufficient capacity—columns of proper spacing—aisles of adequate width—and floor space requirements at point of use on production line to conform to the size of the unitized load of packing materials and sundry raws in direct ratio to their use, to enable the fullest possible employment of mechanized equipment.

You are all familiar with the old practice of receiving knocked-down cartons tied with twine, in bundles of 25 or 50, cumbersome to handle and liable to damage. The day of such bundles is fast disappearing. The suppliers now prepare unitized loads which protect product in transit and sharply reduce the labor involved in moving goods from the transportation conveyance to the point of use.

Integration with other divisions of a company cannot exist without communications. In this age of specialization, to deny communications to a specialist, a material handling engineer, a traffic manager, or a production manager, effectively limits his productivity. A specialist in one division must integrate his activities with specialists in other divisions.

Our new Hammond Warehouse is a good example of carrying automation through to the eventual shipping platform. All goods move from the case sealer by means of two common conveyors, directly into the storage warehouse. Within the warehouse, electronic case selectors automatically divert each pack and brand to separate accumulator belts to await their turn for automatic palletization. The degree of efficiency achieved through this process is beyond belief. Even to the experienced material handling expert, it is fascinating to watch the almost human action of the automatic case selectors unerringly taking off any one of six different packs on to six different accumulator belts, and then to watch one palletizer automatically change its interlocking pattern to produce any one of the six different pallet patterns designed to efficiently utilize the cube of the pallet, with proper interlocking features.

After the loaded pallet is discharged from the palletizer, it can either be removed at the point of palletization by fork trucks, or automatically moved to a lower floor by means of automatic lowerators. A further innovation is the ability to discharge any particular item in production to a predetermined location close to its eventual point of storage, to minimize the distance to be traveled by fork trucks. This warehouse is a perfect example of the elimination of drudgery, of providing the worker with mechanical equipment to increase his output, thereby permitting management to continue to provide an ever-increasing standard of living. It is this process in our free enterprise system that enabled our country to pro-

gress from the horse and buggy to the giant Diesel engine. While there may be a few blacksmiths today, there are a multitude of positions replacing the smithy. Because of the worker's willingness to join with industry in the progress of our mechanized age, he has the energy to enjoy his leisure and the fruits of his efforts at the conclusion of his work-week.

Despite this fact, occasionally a voice is raised as to the ability of industry to absorb those employees whose work is now performed by automatic devices. The history of our industrial growth is living proof of advantages to the worker. Official governmental labor indices reveal that in the year 1900, the U. S. labor force totaled 29,025,000; in 1930, 41,897,000; in 1940, 54,308,000; in January, 1955, 66,700,000—an increase in 50 years in excess of 100%. Specifically speaking, our new Hammond warehouse, despite all the electronic and materials handling devices, resulted in greater employment. For example, March, 1952—161 employees; March, 1954, with the new warehouse in operation, 205 employees. It is simply the constantly recurring economic process of greater efficiency permitting greater volume.

In the last year, there have been developments in unitized handling which foretell an even brighter future. We are all aware of the back-breaking labor involved in handling bulk material in bags. There is now available to the alert user collapsible rubber drums which permit the unitized handling of as much as 12,000 pounds of powders or liquids. Because of their design, these enable the transfer of contents from container to storage bin in a matter of minutes, rather than hours. Under former circumstances, a worker handling a load of carbon black finishes with the appearance of a miner emerging from the pit. This same employee could now handle carbon black in white tie and tails.

Our railroad car leasing companies have aggressively approached the problem of automation and efficiency in handling. Covered hopper cars are now available which reduce unloading time 80% in handling quantity receipts of powders. 150,000 pounds of chemical in less than two hours!

The development, in recent months, of the clamp type fork truck could well revolutionize the storage and movement of packaged goods. The unitized handling of packaged goods from point of production to ultimate customer has been handicapped by the problem surrounding the economic return of pallets, or their replacement by low-cost disposable pallets. We have struggled for years, attempting to determine the optimum pallet dimensions to enable fullest use of the pallet area for various sized packages. Now that the pressure clamp has been engineered to permit the operator to effectively control the pressure applied on the unitized load, even fragile packages can be successfully moved in multiple units. It is now simply the basic evaluation of the pounds pressure required to offset the pull of gravity on the total pounds lifted. This development will permit higher piling without damage to lower containers, because of the elimination of the overhang frequently experienced, where pallet area was smaller than the total area of multiple cartons. The pressure will be equally distributed over the entire bearing area of the product stored. Those of you who have lived with the pallet problem know only too well the substantial investment

and maintenance cost inherent in such handling.

One of the most perfect examples of automation is the new so-called "Piggy-back Service" of the railroads, providing prompt movement from point of production to ultimate consumer, as it is now possible to bypass time-consuming terminal and switching facilities at origin and destination. Piggy-back operations will soon embrace unit-load operations. Under this system, unit loads of merchandise are loaded on trailer trucks at your dock and hauled to the railroad yard for placement on flat cars. The trucks are removed at destination for direct delivery to the customer and unloading by fork truck in unitized loads. In many instances, a unitized load may involve as much as 160 individual pieces. This represents a potential saving ratio of 160 to 1, multiplied by the number of times handled — in warehouse — out warehouse — at the shipping dock — at the origin railroad terminal — at the destination railroad terminal— into delivery truck — and, finally, at the customer's.

### The Coordinated Warehouse

A recent innovation, which could radically change the marketing of the everyday essentials used to feed, clothe and house our citizens, is the coordinated public distribution warehouse, which in one fell swoop serves not only the manufacturer, but the intermediate distributor and, finally, the shopkeeper supplying the public. The activation of such warehouses could completely outmode present distribution methods, which require each manufacturer to deliver small quantities to many customers throughout the metropolitan areas.

We are all familiar with the congestion in many of our large cities, brought about because of the many trucks making many deliveries to many stores. Under the proposed system of operation, each manufacturer supplying the various outlets in the community will maintain inventories of their products in this centralized distribution warehouse.

All manufacturers and transportation have been aware of the prohibitive cost involved in making minimum deliveries — the tremendous amount of lost time and motion. From the viewpoint of the store owner, how much more efficient it would be to have one truck of 20,000 lbs. deliver all the items needed, rather than 40 trucks averaging 500 lbs. delivering for each manufacturer! It might be said that each competitive manufacturer would not want to lose his identity in effecting delivery to his customers. In actual practice, he loses his identity in the railroad merchandise car or the truck lines' merchandise truck. His merchandise is freely intermingled with that of other manufacturers who might be using the same carrier; and undoubtedly, on many occasions, his product is delivered with that of his competition on the same vehicle.

The centralized distribution warehouse, as planned, utilizes the philosophy of the individual merchandise cars from various origins to consumers in a given distribution area, and consolidates it on an area-wide basis. The goods of the manufacturers from various origins come to rest at a central warehouse location, are intermingled, and simultaneously released for delivery in one truckload to the customer. In addition to the economic benefit to the manufacturer, it permits the individual distributor to sharply reduce his investment in inventory.

### A New Era of Distribution

We are only beginning to enter an era of material handling and automation which will enable industry, under our American free enterprise system, to make more efficient use of manpower. The speed and degree to which this is accomplished rest with the industrial executives. No expense and effort has been spared to improve sales and production methods, but, so far, relatively little thought has been given to distribution and the practice of automation. Unfortunately, engineering — as a general rule — has ceased at the end of the production line.

Automation — material handling — distribution: If we could but correlate all these expenses incurred after the product is produced, and until it is delivered to the customer, we would quickly understand the magnitude of this field. They are, in effect, expenses which add to the cost of the product, but not to its original, basic value. Your trafic manager, your material handling engineer, or your warehouseman — whoever you hold responsible —should have a seat in management councils and be given an opportunity to prove the contribution that he can make to the profits of your company.

On the other hand, the degree and the speed with which management accepts the part that automation, traffic, transportation and distribution can play in the final profits of the company depend upon the ability of the party responsible for these functions. It is his obligation to be fully informed on matters not only concerning his immediate responsibilities, but to understand the effect of his operations on other departments of the company; and, further, to have the ability to accurately and objectively portray to his management the benefits of his recommendations and their relationship to over-all operations.

The traffic manager today cannot consider the unit cost of transportation between point of origin and destination without considering his handling costs to utilize that carrier, as well as the effect of the means of transportation on the cost of unloading to his customer. When evaluating handling costs, it is entirely possible for us to use a higher-rated form of transportation, and still achieve a lower over-all cost to the company. The same considerations apply to the material handling engineer and to the warehouseman. By coordination of effort on all these functions, and their integration under management technically familiar with the implications of this ever-growing field, industrial management can contribute to profits and better living for the American citizen.

# Current Michigan Business Conditions

General Business activity throughout Michigan, as in the nation, has been at a high level during the year to date. Industrial production has been rising to near-record levels; total employment figures in the state are at the highest level since May, 1953; unemployment is now at the lowest point since July, 1953; retail sales have been above last year's level throughout most of the state; construction activity has also been high. The only area of the state that has not enjoyed this economic revival is the Upper Peninsula, and the farm situation continues in a somewhat depressed state.

Checkbook spending (in the form of bank debits), one of the most widely used barometers of business activity, provides one good indication of the high level now being enjoyed throughout most centers in the state. By May, all centers, except Marquette and Sault Ste. Marie, had exceeded 1954 figures, and this general condition is a good reflection of the current general state of business.

Retail trade has continued at a substantially higher level than in 1954. Sales tax collections (representing business of the previous month) have been at record levels, exceeding 1953 and 1954 levels, thus continuing the trend begun in December. Preliminary figures indicate that this was true through the first five months of the new year.

Department store sales, while exhibiting their customary seasonal drop in January, have shown substantial strength in all of the major population centers in the state during 1955 to date. Sales during March in the pre-Easter period were at record levels.

Electric power consumption in the state continued at increased rates during 1955. The increase in industrial consumption was especially marked, and is another indication of the high level of industrial activity in the state during 1955.

Automobile production has been at an all-time record for all of 1955 to date. Motor vehicle factory sales in the first third of 1955 totaled 3,246,758 vehicles, making the best four-month production period in the history of the automotive industry. March's total of 894,597 vehicles was the best monthly sales figure in history. March's 791,280 passenger car sales, also a monthly record, represented a 49 percent increase over last year's March figure. Motor truck factory sales of 387,616 in the first four months have been above the 381,208 total for last year. Motor coach sales of 1,210 units in the first four months have been below the figure of 1,409 for the corresponding period a year ago.

Employment figures in the state are now at the highest level since May, 1953. Correspondingly, unemployment was at the lowest level since July, 1953. The general level of improvement, although most significant in the Detroit area, was distributed through most of the important labor areas of the state. The Upper Peninsula, however, has been a notable exception; total employment is below 1954 levels and unemployment continues at increased levels. Statewide employment is expected to continue at gradually increased numbers into the early part of the summer because of seasonal demand in construction and tourist industry — barring unforeseen developments.

**Bank Debits**

| City | Bank Debits (thousands of $'s) Jan. '55 | Feb. '55 | Mar. '55 | Apr. '55 | Percentage Change from Previous Year Jan. '55 | Feb. '55 | Mar. '55 | Apr. '55 |
|---|---|---|---|---|---|---|---|---|
| Adrian | 21,135 | 19,249 | 22,784 | 23,352 | +11.9 | +15.0 | +18.4 | +23.0 |
| Battle Creek | 70,574 | 65,076 | 68,633 | 72,161 | + 8.1 | +11.6 | + 5.5 | +16.6 |
| Bay City | 45,518 | 40,955 | 45,051 | 45,158 | + 7.5 | + 7.3 | + 0.1 | + 3.5 |
| Detroit | 5,466,270 | 5,028,729 | 6,336,817 | 5,592,936 | +12.1 | + 6.4 | +10.5 | + 9.1 |
| Flint | 163,925 | 152,354 | 170,377 | 166,193 | +22.5 | +25.8 | +17.8 | +22.3 |
| Grand Rapids | 290,859 | 269,666 | 316,336 | 289,036 | + 8.2 | +12.8 | +14.8 | + 9.7 |
| Jackson | 88,531 | 77,987 | 97,757 | 85,385 | +11.7 | +14.1 | +27.7 | +18.4 |
| Kalamazoo | 115,454 | 106,914 | 127,448 | 113,956 | + 9.3 | + 9.1 | +12.4 | +13.4 |
| Lansing | 132,698 | 126,641 | 137,510 | 149,478 | — 7.7 | — 0.9 | — 2.0 | + 5.1 |
| Muskegon | 76,924 | 72,062 | 77,162 | 78,231 | + 2.8 | + 9.3 | — 1.4 | +13.2 |
| Port Huron | 38,114 | 34,068 | 37,961 | 37,606 | +13.7 | + 7.0 | + 8.9 | +16.2 |
| Saginaw | 102,660 | 98,503 | 107,309 | 108,515 | + 8.1 | +12.9 | + 8.4 | +14.2 |
| Escanaba | 10,941 | 9,630 | 11,262 | 9,641 | +11.2 | + 4.4 | + 2.6 | + 2.7 |
| Marquette | 10,950 | 9,393 | 10,801 | 10,213 | + 5.6 | — 6.7 | — 8.7 | — 0.3 |
| Sault Ste. Marie | 10,497 | 9,388 | 10,264 | 9,321 | + 4.8 | +12.4 | + 2.1 | — 5.3 |

Source: Federal Reserve Banks of Chicago and Minneapolis

**Department Store Sales**

| | January, 1955 Percent change from Dec. '54 | Jan. '54 | February, 1955 Percent change from Jan. '55 | Feb. '54 | March, 1955 Percent change from Feb. '55 | Mar. 54 | April, 1955 Percent change from Mar. '55 | Apr. 54 |
|---|---|---|---|---|---|---|---|---|
| Battle Creek | —54 | +17 | —14 | + 2 | +95 | +53 | +24 | +49 |
| *Detroit | —56 | +10 | — 9 | + 8 | +42 | +18 | +13 | + 9 |
| *Flint | —56 | +12 | —11 | + 4 | +33 | +12 | +28 | +12 |
| *Grand Rapids | —58 | + 4 | —12 | — 5 | +38 | + 6 | + 8 | + 3 |
| *Jackson | —62 | +17 | — 7 | + 2 | +29 | +11 | +27 | + 3 |
| *Kalamazoo | —66 | 0 | + 8 | + 3 | +11 | +12 | +19 | + 8 |
| *Lansing | —58 | + 8 | — 7 | +13 | +30 | +21 | +20 | +19 |
| Muskegon | —61 | +14 | —15 | 0 | +42 | +18 | +40 | +19 |
| Port Huron | —67 | + 1 | —11 | — 1 | +39 | +16 | +47 | +10 |
| *Saginaw | —53 | + 8 | —18 | + 5 | +35 | + 9 | +47 | +12 |

*Metropolitan Areas

Source: Federal Reserve Bank of Chicago

**Motor Vehicle Factory Sales from Plants in U.S.**

| | Factory Sales Jan. '55 | Feb. '55 | Mar. '55 | Apr. '55 | Percent Change from Previous Year Jan. '55 | Feb. '55 | Mar. '55 | Apr. '55 |
|---|---|---|---|---|---|---|---|---|
| Passenger Cars | 635,513* | 677,705* | 791,280 | 753,434 | +39.8 | +51.7 | +48.9 | +40.9 |
| Motor Trucks and Buses | 89,866 | 67,237 | 103,317 | 128,406 | — 6.9 | —23.1 | + 1.8 | +32.2 |

*Revised

Source: Automobile Manufacturers Association

**Electric Sales in Kilowatthours**

| | Thousands of KWH Sales Dec. '54 | Jan. '55 | Feb. '55 | Mar. '55 | Percent Change from Previous Year Dec. '54 | Jan. '55 | Feb. '55 | Mar. '55 |
|---|---|---|---|---|---|---|---|---|
| Residential | 506,995 | 559,108 | 557,292 | 546,643 | + 9.0 | + 6.0 | + 9.2 | +13.4 |
| Commercial | 287,008 | 296,374 | 292,270 | 294,711 | + 6.3 | + 5.1 | + 7.2 | +11.8 |
| Industrial | 820,674 | 826,212 | 856,589 | 867,514 | +16.8 | +21.2 | +30.3 | +28.2 |

Source: Edison Electric Institute

**Non-Farm Employment**

| | State of Michigan | Detroit Met. Area | Flint | Grand Rapids | Lansing | Saginaw | Upper Peninsula |
|---|---|---|---|---|---|---|---|
| Jan. 15, 1955 | 2,476,000 | 1,402,000 | 135,700 | 116,800 | 76,800 | 55,900 | 77,400 |
| Feb. 15, 1955 | 2,486,000 | 1,407,000 | 137,500 | 116,800 | 77,500 | 56,100 | 77,100 |
| Mar. 15, 1955 | 2,502,000 | 1,417,000 | 138,800 | 117,300 | 78,100 | 56,700 | 75,800 |
| Apr. 15, 1955 | 2,538,000 | 1,440,000 | 140,400 | 117,600 | 79,500 | 57,400 | 77,000 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Percent change from year ago: | | | | | | | |
| Jan. 15 1955 | +0.4 | +0.7 | +6.6 | —0.4 | —0.8 | —1.2 | —2.9 |
| Feb. 15, 1955 | +2.5 | +3.7 | +5.3 | +0.2 | —0.8 | —0.4 | —3.4 |
| Mar. 15, 1955 | +3.6 | +4.4 | +8.1 | +3.3 | +0.1 | +2.3 | —3.4 |
| Apr. 15, 1955 | +4.7 | +5.8 | +7.9 | +2.0 | +1.8 | +3.4 | —1.7 |
| **Total Unemployment** | | | | | | | |
| Jan. 15, 1955 | 153,000 | 86,000 | 4,300 | 4,900 | 3,000 | 2,200 | 11,800 |
| Feb. 15, 1955 | 142,000 | 80,000 | 4,200 | 4,900 | 2,900 | 2,100 | 11,800 |
| March 15, 1955 | 120,000 | 65,000 | 2,800 | 4,300 | 2,200 | 1,700 | 12,700 |
| Apr. 15, 1955 | 92,000 | 48,000 | 2,600 | 3,300 | 1,700 | 1,200 | 11,800 |
| Percentage change from year ago: | | | | | | | |
| Jan. 15, 1955 | —13.1 | —19.6 | +16.2 | +53.1 | —21.1 | +10.0 | +32.6 |
| Feb. 15, 1955 | —33.6 | —42.9 | +16.7 | +25.6 | —14.7 | — 4.5 | +18.0 |
| Mar. 15, 1955 | —44.4 | —51.9 | —36.4 | —23.2 | —40.5 | —39.3 | +12.4 |
| Apr. 15, 1955 | —56.8 | —64.2 | —25.7 | —35.3 | —52.8 | —53.8 | + 0.9 |

Source: Michigan Employment Security Commission

# Do You Know These Michigan Towns?

1. The Chippewas called it Mishqua Sibe; settlers called parts of it Hardscrabble and La Belle Fontaine. One man, who changed the course of western civilization, put this place on the map, but the name it bears today is not his. It is called after a general in the War of 1812.

2. Three colleges, six hospitals, two symphony orchestras. The world's largest mint refining center, and manufacture of everything from snow plows to paper towels, including the ink for this magazine. You could hardly find a better place to live halfway between Chicago and Detroit.

3. It Never Rains But It Pours here, and we don't mean the annual mean precipitation. One of the best natural harbors on the Lakes. Home of the world's largest forest nursery. Year-round sports facilities nearby, and summer theater in town.

4. They changed the name from Frenchtown in honor of a president who was going to visit — but he never came. Scene of an Indian massacre of hundreds of white prisoners, and later of a bloodless war, in which Michigan lost a battle but gained the Upper Peninsula.

*(Answers on Page 32)*

# THE HOUSING BOOM: a Reappraisal of Demand Forces

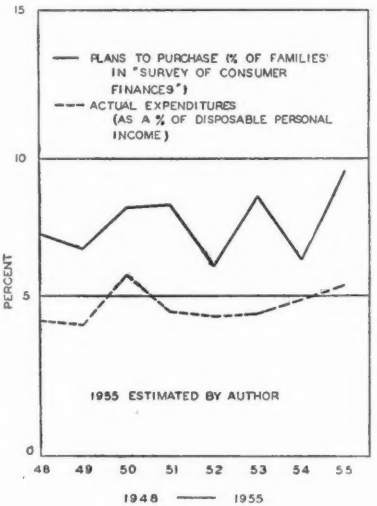
By *ARTHUR E. WARNER**

*What factors make a housing boom? Not necessarily the ones you would think. This article discusses present and predictable future demand for new home building.*

At the present time, the housing industry is one of the primary contributors to the high level of national output. New nonfarm housing starts are being made at an annual rate of more than 1,400,000: this is generally considered a very high rate even for boom periods. Hence analysts of contemporary economic conditions are even more interested than usual in the picture of home building. The greatest concern, however, is not over the current rate, but over the prospects for continuing at or near the present level during the future. A high level of housing activity is an economic factor that cuts both ways: that is to say, the more activity, the more concern over its ability to continue very long. Now in the five years since 1950, nearly six million nonfarm dwellings were completed. Can we expect such a trend to continue at anything like the present rate, and if so, for how long?

### "Always Assuming That . . ."

There is a fundamental assumption underlying any confident prediction in the economic field in these uneasy times: that international relations are not going to be altered drastically in the foreseeable future. Any significant change in the cold war situation, calling for a readjustment in allocation of resources in the United States naturally would alter economic balance; this goes without saying. Taking into account this reservation, the writer views the prospects for the future as being equally as bright as at the present time.




With this basic assumption in mind, it appears that any analysis of the housing situation must take into account the dynamic forces which control demand for housing services. Changes in consumer spending for housing are immediately felt at the manufacturing level, for producers of housing, unlike producers of many other consumer goods, base manufacture on immediate

*Dr. Warner is Assistant Professor of Management at Michigan State College.

consumer demand, rather than taking inventories into account.

Demand for housing in the highly complex American economy is almost entirely unrelated to any basic need for shelter as a means of protecting a family group from the vicissitudes of nature. In an advanced economy where development of productive capacity has long since pushed output and consumption to a level well above that of bare subsistence, demand for housing is a function in the first instance of income and income prospects, taste, patterns of social acceptance, and design.

It follows then that analysis of the current housing boom (or at any other time) should be based upon a critical evaluation of such dynamic factors as mentioned above. Much analysis of the current situation, however, has emphasized population changes, marriage rates, family formation, and migration patterns in an attempt to arrive at a so-called "basic need" for housing services. While it is true that such factors are important in estimating sociological *need* for housing, it is also apparent that it is not *need* but *demand* that is the factor being subjected to scrutiny.

### Income as Affecting Demand

An increase in family income naturally increases the *possibility* of increasing the amount spent on housing, and frequently intensifies the *desirability* of improving its position as a consumer of housing. The desire to improve the family's standard of housing seems to be a deeply ingrained trait in the United States, and one commonly accepted measure of the standard is ownership of a single-family detached housing unit.

During the period that roughly approximates recovery from the great depression of the 1930's, personal incomes have risen quite steadily. Measured in constant (1954) prices, disposable incomes of individuals have increased more than 70 percent, moving from $146 billion in 1940 to $254 billion in 1954. The amount of housing added to the nation's inventory has increased sharply during the same period, but the increase has not kept pace with the increase in income. By way of comparison, in 1940 substantially less than one-half of the housing stock was 30 years old or over, while in 1954 the ratio was almost 50-50. Likewise, the quality of housing has deteriorated from year to year. The Census Bureau estimates that nearly 10,000,000 houses now in use are unfit for human habitation.

### More People With More Money

Of even greater significance is the tremendous change that has taken place during the same period in the distribution of income. The number of family units with income of $4,000 or more has increased by about 75 percent since 1940, and in 1954 approximately 23 million families were within this category. At the same time, mortgage underwriting terms have undergone an important change due to the influence of the federal programs of mortgage insurance and guaranty. The mortgage term has been increased to as long as 30 years, and down payments and monthly ones likewise have been sharply reduced. Such changes have resulted in an "income effect" in addition to the increases noted above, for their impact has served to lower the amount of annual income required to permit a family to

[1]"Real Estate Economics: A Return to Fundamentals", E. E. Edwards, *The Appraisal Journal*, April, 1949.

increase its level of housing. Typically, this increase has meant the purchase of a new or used one-family house.

### The Factor of Confidence

Changes in the public's attitude toward prospects for income increases or decreases have hitherto exerted at least as much influence on housing demand as have actual changes in income during a given period. In the past, little current information has been available for use in evaluating public confidence in the future. The Federal Reserve System's "Survey of Consumer Finances", a tabulation of a sample of the population's views, plans and attitudes about their financial status, has afforded accurate and useful information. The most recent survey results available[2] indicate that a greater number of family units have confidence that the future will bring good times and higher levels of income than at any other time since the surveys have been made. Early in 1955, 64 per cent of them expected that general business conditions would continue good or fair during the next 12 months. By comparison, 53 per cent held a similar belief in 1948 and only 51 per cent expected good or fair times in 1954.

Supporting their belief that economic conditions are favorable, almost 10 per cent of the families asserted that they planned to purchase housing in 1955. In 1954, when 1,220,400 new houses were started, less than 7 per cent of the family units indicated plans to purchase homes. It appears then that plans to purchase housing increase with confidence in the future.

### Conclusion

Judging from the dynamic factors which contribute to demand for housing services in the United States, there appears to be little or no basis for believing that the industry cannot continue to turn out houses at or near the present rate as long as incomes remain high. However, the rate of housing production could drop sharply in the event of a downturn in incomes or an increase in pessimism about the future.

Prospects for the future recently have been appraised by some of the most mature economic thinkers in the nation. They affirm the possibility of a national output of $500 billion *more* within the next decade[3], as against 370 billions at present. Other predictions indicate the possibility of even greater economic growth. If they prove to be valid, there is every reason to believe that housing production will enjoy commensurate growth.

[2] *Federal Reserve Bulletin*, March 1955, pp. 249-55.

[3] *Economic Report of the President*, January, 1955.

## CHANGE OF NAME

Many an observant reader, after scanning our cover or masthead, will ask, "Shouldn't you say 'Michigan State *University*', now?" No, we have not made another bobble, for at the date of printing this institution's name still officially is Michigan State College. July 1 is the legal date of the name change.

Having brought up the subject, we would like to say also that only the name is changing. This institution has been a university (with a small "u") in every sense of the term for many years. Its character, policies and philosophy of service will not change on July 1. They will be in their constant evolution to meet the needs of our state.

# FRANK WILLIAM TAUSSIG: INFLUENTIAL ECONOMIST

*By JOHN M. HUNTER**

*Another in our series of profiles of great economists.*

When Frank W. Taussig died in November, 1940, he was beginning his fifty-seventh year of activity as an economist. This longevity is significant, but of much greater import was his tremendous activity and influence upon students, public policy, and the development of economic thought.

His early educational experience and assignments evidence the great promise he showed even as a young man. He graduated at the age of twenty, the second youngest in his class and second in scholarship, from Harvard College in the class of 1879. The following year was devoted partially to Roman Law and political economy at the University of Berlin. As a graduate student at Harvard, he became the secretary to President Charles W. Eliot. By 1882, he was an instructor in political economy and in 1883 was awarded the Ph.D. His dissertation *Protection to Young Industries as Applied to the United States* prefaced his life-long interest in the tariff and was published as a book the same year. There followed a law degree *cum laude* in 1886, but a previous appointment as assistant professor in political economy forever weaned him away from the practice of law. From his base at Harvard (a full professor in 1892 and Henry Lee Professor of Political Economy from 1901 to 1935 when he retired) his deanship of American economists was developed, and his influence reached far beyond the confines of the Harvard Yard.

Perhaps his greatest impact was through his *Principles of Economics,* composed (because of his excellent style, "composed" is a better word than "written") in the years 1905-11. For years, this was a standard text read by thousands of college students throughout the world. But his major and continuing interest was the problem of international trade, and more specifically, the tariff. In this area his audience was smaller, but his output greater and even more authoritative. His *Tariff History of the United States* (first published in 1888, ninth edition, 1930), *Some Aspects of the Tariff Question* (1915, third edition, 1930), and *International Trade* (1929) are his best known works in this field. In direct contact with students, Taussig's reputation as a teacher was superb.

Taussig's influence extended beyond the classroom, though. As early as the 1890's, he was officially embroiled in matters of public policy both large and small—a participant in the fight against free silver, a member of the Cambridge school committee, a member of the governor's commission on Massachusetts tax laws, a delegate of the Boston Merchants' Association to the Indianapolis Monetary Conference of 1898. He became most active in public affairs during the times of World War I. From 1917-1919, he chaired with unqualified

*Dr. Hunter is Associate Professor of Economics, Michigan State College.

success the newly-created Tariff Commission. During and after the war, he served on the price fixing committee of the War Industries Board and worked in the milling division of the Food Administration. More important, he became a confidant and advisor of President Wilson whom he later served in Europe as a member of the advisory committee on peace and as a member of the sub-committee on tariffs and commercial treaties. On policy issues, he "fully accepted for himself the tradition that attributes to the economists the right and duty to shape and judge public policy, to lead public opinion, and to define desirable ends."* The Tariff Commission minutes read, "For many years, his (Taussig's) knowledge of the tariff history and tariff policies of the United States have surpassed that of any other living man. His books and numerous papers . . . form a collection of ably interpreted information to which students and lawmakers have long turned for guidance . . . He has combined in a high degree the vision of the educator and of the theorist with the sane judgment and common sense of the practical business man."*

Taussig's contributions to economic thought were numerous. He served as editor, in fact as well as in name, of the *Quarterly Journal of Economics* (one of the leading economists' journals) for forty years. He studied and wrote on many phases of economics (to his credit were sixty publications in the years 1920-34). Paradoxically, one of his major achievements arose from failure. Taussig was a classicist and never really could divorce himself, especially in the field of international trade, from the formulations of the theory by David Ricardo and John Stuart Mill. His difficulties arose from his acceptance of and efforts to work with a labor theory of value. His vigorous, but futile, attempts to rationalize these formulations with logic and reality convinced a group of young men that the approach was erroneous. Though the efforts of Taussig failed, they contributed a great deal to the later accomplishments of Haberler, Ohlin, Viner, Williams, if for no other reason than that a blind alley was made evident. Taussig's writings clearly indicate his dissatisfaction with the classical approach, but he could never quite get away from it.

Taussig's preeminence in the field of economics was recognized formally during his lifetime. He received honorary degrees from Brown (1914), Harvard (1916), Cambridge (1933), Bonn (1928), Northwestern (1920), and the University of Michigan (1927). He served as president of the American Economics Association (1904-05) and was commander of the Order of the Crown in Belgium and a chevalier of the French Legion of Honor. His professional accomplishments made him a great economist; his understanding of humanity in general and his students and associates in particular proved him a great man.

*Cited in the National Cyclopedia of American Biography, Vol. XXX, pp. 68-9.

ANSWERS TO "Do You Know These Michigan Towns?

1. Dearborn; 2. Kalamazoo; 3. Manistee; 4. Monroe.

# UNDERGROUND STORAGE OF NATURAL GAS

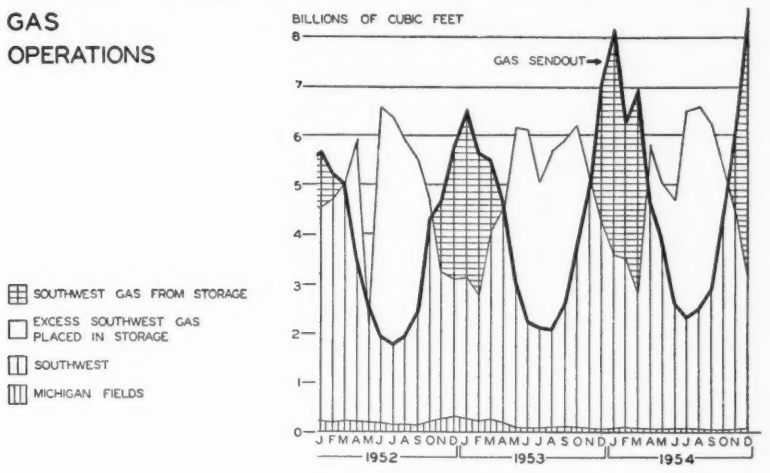
*By ANNE C. GARRISON**

*Past articles have stressed the chemical industries based on Michigan's salt beds. We have another underground asset storage space. Where Michigan natural gas once accumulated, we now keep gas from Texas, 1,300 feet below the cow pasture.*

In the Old Testament, Joseph warned Pharoah of seven impending years of plentiful harvests to be followed by seven years of famine. By storing grain from the fat years, the land of Egypt had enough to eat during the lean years, and some left over for export. This story is the earliest example of the economic principle that has since been applied in many ways. The Federal Reserve System and the "ever-normal Granary" of the Department of Agriculture operate on this plan, as we all know. It may be less well known that the natural gas industry follows exactly the same practice.

Consider a typical community in an area served by gas pipeline: say a Michigan town where many houses are heated by Texas natural gas. The amount consumed will be tremendous during a Michigan winter, while in the summer months home water heaters and local industry will use a much smaller amount. If it were not for storage facilities close at hand, the gas

*Mrs. Garrison is Associate Editor of *Business Topics*.

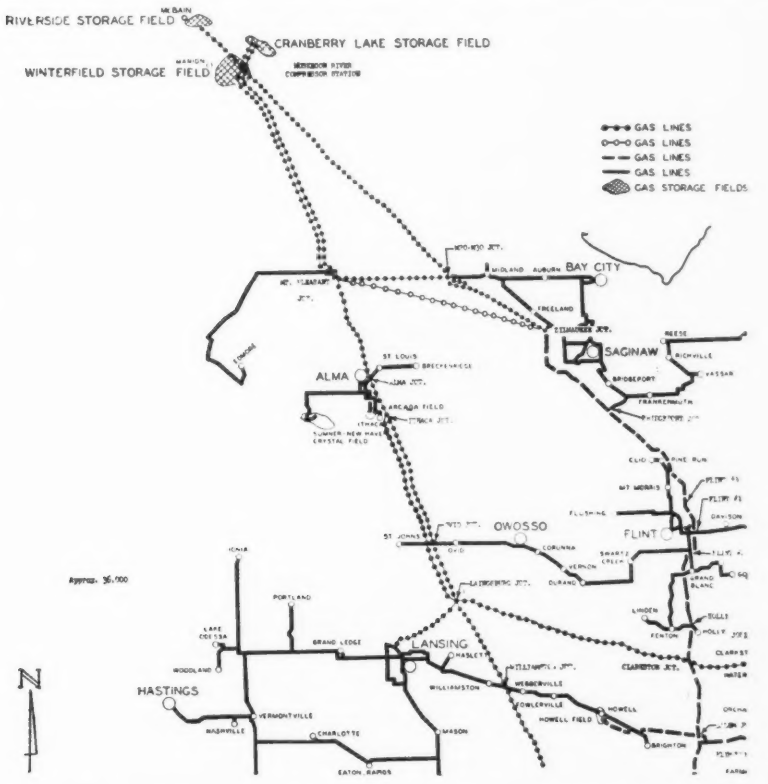

GAS OPERATIONS
BILLIONS OF CUBIC FEET
GAS SENDOUT
SOUTHWEST GAS FROM STORAGE
EXCESS SOUTHWEST GAS PLACED IN STORAGE
SOUTHWEST
MICHIGAN FIELDS
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1952
1953
1954

company would have to have more lines to serve the winter demand (and be an expensive liability the rest of the year), or they would fail to meet customer demand. Since neither alternative is practical, there must be local storage to balance the load.

*What Kind of Storage?* Gas can be kept in several types of containers, only two of which are likely to occur to the layman. Large tanks are picturesque but expensive. Closed-end pipe (known as "bottles" in the industry) can be used. But the cheapest, most effective, and certainly the most ingenious method of storage utilizes natural underground areas. Such storage dates back to 1914, but was not thoroughly exploited until the heavy industrial demand of the last decade. Three different types of subterranean areas are used: depleted oil fields, depleted gas fields, and aquafer, or water-bearing, formations. The principle of the first two is very simple: where oil or gas was once stored by nature without leakage and loss, it can be stored again. The principle of the third type is a little different: a porous formation saturated with water has gas forced into it under pressure. Though water is not highly compressible, its slight compressibility over an area of many acres is sufficient to allow for considerable gas storage. Since the gas is lighter than the water, it cannot leak out below the water level, and the fields chosen are dome formations where the layers above are impermeable.

In our own state, the storage is almost all the depleted gas field type. Our own natural gas supply is reaching the vanishing point, but as things are now, Texas gas comes in in sufficient quantities in the summer to serve our needs and to build up a comfortable margin of reserve in the very beds that once produced native gas. The two companies in the state, Michigan Consolidated Gas Company (the larger) and Michigan Gas Storage Company (a subsidiary of Consumers Power) have in all twelve pools for underground gas storage, comprising 910 producing wells in all. Michigan Gas Storage Company has two compressor stations, one on the Muskegon River near Marion, the other at Freedom, near Manchester, that compress incoming gas mechanically by means of pistons with double-acting valves. This raises the pressure sufficiently to force the incoming gas into the field against the pressure of the gas already in storage. A glance at the map will show the incoming pipe system, the three upstate storage areas, and the network of outgoing gas lines of the Michigan Gas Storage Company. It should be remembered that the complete picture would also show the comparable system of Michigan Consolidated as well.

*A Good Field:* There are certain definite requirements for a good gas storage field. It has to be in a geological formation large enough to provide for sufficient storage; to be impervious not only above and below but also laterally (so you don't keep pumping free gas into the next county); the storage layers have to be permeable, for the gas does not fill a cave-like hollow but the very pores of the rock. At the Winterfield and Cranberry Lake fields of Michigan Gas Storage Company, the formation used is the Michigan Stray sand, at a depth of approximately 1,300 feet. This is a sandstone with an average porosity of about 15 percent. A certain amount of the gas naturally present, or pumped in, has to remain




in the field at all times. This "cushion gas" is a necessary safeguard against the intrusion of water, which otherwise would seep in and ruin the field.

Once a good field is located it has to be made available to the company either by outright purchase of gas rights or by lease. This can be a very complicated business in itself. However, when this legal business is completed and the area is available for working, it is covered with a network of wells through which the incoming gas is pumped into the ground. In some cases existing wells are used. The entire operating field is "dry-hole ringed", to use the technical term: that is, an outer area completely surrounding the operating field is spotted with observation wells, from which tests can be made periodically to detect any leakage of gas from the field itself.

*Growth and the Future:* The search for new storage areas goes on constantly, for the gas industry is confident that the need for its product will continue to grow. Judging by the statistics of the last ten years their anticipation is justified. Throughout the

country there has been a growth of over 200% in that period. Seventeen states now employ natural underground storage, and the estimated reserve capacity is estimated to be 1,860 billion cubic feet. Michigan holds the fourth place in the amount of gas stored and used. As for other nations' use of the storage method, this may be expected to grow phenomenally, for in the entire world only Canada employs it aside from our own country. Plans have been undertaken to introduce the principle of underground storage into France, but it has not yet been put into practice.

## PARKE, DAVIS AND THE FIGHT AGAINST POLIO

As we live through the climax of the dramatic fight against poliomyelitis, let us recall with thanks that it was a Michigan firm, Parke, Davis, that was an illustrious pioneer in vaccine research and production, and is now one of the largest producers of polio vaccine.

The firm's scientists began intensive work on the polio virus in 1950. In 1954 it made more than 50 per cent of the vaccine used in the nation-wide field trials, and at present it is producing one million cubic centimeters a week, almost all of it for the National Foundation for Infantile Paralysis.

The picture above shows safety tests being run in upright tubes and plastic disc sheets at the polio vaccine laboratories of Parke, Davis & Company. Color reaction and appearance under the microscope allow detection of any live virus present in the vaccine samples.

# The World is My Brother

Those few words express a feeling that is increasingly shared among Michiganders. World War II, the American blood shed in Korea, and challenges in every part of the globe have brought home to us full realization of our international involvement. That Michigan's universities should translate this conviction into concrete help across the seas follows logically.

The work of Michigan State in other lands is noteworthy. *Business Topics* has presented articles on two projects: the team on Okinawa that has guided the development of the University of the Ryukyus (in our issue of June, 1953) and those at Sao Paulo giving similar aid to its new business administration school, Brazil's first (November, 1954). To bring our readers up to date, we are pleased to say that the Ryukyus university has progressed to the point where nearly 1,500 of their young people can be admitted.* Six Michigan State faculty members are there today, continuing to direct its progress. The Sao Paulo venture is equally successful and a great credit to our four professors down there.

These pages have not mentioned technical help to the Pakistan government or the Caribbean islands. Then there are the seven Michigan State men in Colombia, spurring the teaching of modern agriculture desperately needed in that country. Nearer home are four men from our Area Research Center studying technological problems along the Mexican border.

The largest of these efforts is currently beginning in Vietnam. On the opposite side of the world from you, Michigan State's Dr. Edward Weidner is in Saigon to direct the 30-man staff of specialists provided through the Foreign Operations Administration. Nine faculty members from this campus are joining him, together with their wives and children.

What Michigan State people are doing around the world, winning others to going our way, typifies the international work of American universities. We in Michigan recognize our stake in their success.

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*Would you like to enable an Okinawan to be educated? Just $100 would pay his full costs for *an entire year!* Contributions should be addressed to the Ryukyus Student Loan Fund, c/o Comptroller, Michigan State College.

## BUSINESS RESEARCH PUBLICATIONS

The Bureau of Business Research was established in 1951 to assist the Michigan State College faculty in conducting economic and business research, and to serve Michigan business with information and studies. Inquiries should be addressed to the Bureau's director. The studies are usually published, and those currently available are listed below.

RESEARCH REPORTS

3. *Greater Muskegon Consumer Shopping Survey*
7. *Michigan Tourist Survey (Free)*
8. *Monroe Industrial Survey (Free)*
9. *Careers in Hotel and Restaurant Management (Free)*
10. *What Michigan Newspapers Tell About the Schools (Free)*
11. *Winter Resorts in Michigan ($1.00)*
12. *Taxation of Mobile Homes ($1.00)*
13. *Wages, Hours, and Fringe Benefits in Member Stores of the Michigan Retail Hardware Association ($1.00)*
14. *Michigan County Market Data (Free)*